Like its famous predecessor the drawings in particular will assure its appeal to the student microscopist. The biggest single improvement over the original book and its revised editions is the much increased coverage given to sedimentary and metamorphic rocks, which together now account for approximately half the text.

The first twenty chapters deal with igneous rocks, very much in the traditional Harker fashion though the organization is improved and tables of chemical analyses are a welcome addition. There is a minor degree of modernization, for example, komatiites get a brief mention, but as before the text is very largely concerned with the naming of rocks, and the brief description of a large number of specific varieties of broader categories. If you like your igneous petrography old-fashioned you will like this section. Many will rightly argue that straight petrographic description is important, and that to have the information in a readily available textbook is highly desirable. On the other hand the almost complete absence of petrogenetic commentary will be seen by some as an important omission. It is perhaps a pity that those aspects of petrography that can be put to immediate petrogenetic use are barely mentioned, perhaps the most obvious case being the scanty treatment of the textures of cumulate rocks. Pyroclastic rocks, which are a rich source of petrographic interest, are also given much less attention than they deserve. Nevertheless the igneous section is a very useful source of information, even though it is not likely to fire many with an enthusiasm for igneous petrology.

The second section of the book consists of twelve chapters on sedimentary rocks and is an enormous improvement on the Harker original. The coverage is much fuller and a large number of rock types are dealt with in some detail. The nature of the subject is also such that a good deal of genetic comment is inserted in the descriptive sections. It is regrettable, however, that chemical analyses are not also included here. There are many simple petrographic features of sedimentary rocks whose impact is reinforced by a consideration of bulk compositional factors. It is also unfortunate that a fuller account of the classificatory problems of sedimentary rocks is not given. A simple system of nomenclature is adopted throughout but a comparison of some of the more specialized systems would have been useful. This is a point on which the would-be petrologist can become considerably confused.

The final seven chapters face up to the substantial problem of dealing with both the genetic and the descriptive aspects of the metamorphic rocks in eighty pages. Indeed in the present state of the art anything less ambitious would not have been very useful. Inevitably parts of the text will have to be taken slowly and steadily by the reader, but generally the result, at least from the petrographic point of view, is interesting and successful. The theoretical background is not highly developed but at least makes some effort to support the descriptive sections adequately.

The book will be useful to students in both elementary and advanced courses, and because of its comprehensive nature will no doubt be popular.

K. G. Cox

Vaughan (D. J.) and Craig (J. R.). *Mineral Chemistry of Metal Sulfides* (Cambridge Earth Science Series), Cambridge (Cambridge University Press), 1978. xvi+493 pp., 167 figs. Price £19.50.

At long last we have a book on the crystal chemistry of sulphides. That we have had to wait so long has been due largely to the difficulty of developing a comprehensive conceptual framework to accommodate all the diverse members of this complex and interesting category of minerals. Not that the authors have succeeded in developing a unified theory into which all the sulphides and their properties can be neatly pigeon-holed, but they have done an admirable job of lucidly reviewing the various theories that have been advanced, in a way that makes them comprehensible to the non-specialist in solid-state physics or physical chemistry. They then proceed to discuss the properties of sulphides within this theoretical context. Finally, there are comprehensive appendices, which give mineralogical data for all sulphides (although not sulphosalts), known to occur as minerals up to about 1976, ΔG° values of univariant sulphidation equilibria, and invariant points in sulphide mineral systems.

No entirely satisfactory systematic classification of sulphide structures has yet been developed, and the authors of this volume have therefore valiantly joined the ranks of those who would create order out of chaos. Their classification, which they term a pragmatic one, groups sulphides into nine categories, exemplified by the following structural types: (1) disulphide, (2) galena, (3) sphalerite, (4) wurtzite, (5) nickel arsenide, (6) thiospinel, (7) layer sulphides, (8) metal excess, and (9) ring or chain structure. This classification will not be to everyone's satisfaction, particularly those who have their own pet schemes, but in this reviewer's opinion, details of a classification scheme are less important than is the development of an understanding of the underlying principles involved in stabilizing the structures that do exist. This the authors have attempted to do, and have, to a considerable

degree, succeeded. Most of the sulphide structures are interpreted in terms of a blend of molecular-orbital and band theories of chemical bonding.

A chapter on sulphide thermochemistry begins with a basic introduction to thermodynamics, and then moves on to discuss the measurement of sulphur activity and the construction of phase diagrams. Techniques of sulphide synthesis are briefly summarized, and numerous examples of phase equilibria given. A separate chapter is devoted to sulphide equilibria in aqueous systems.

A number of minor topics relevant to sulphide mineralogy are covered, including reflectivity and hardness measurements, electrical and magnetic properties, sulphur isotope fractionation, and various kinds of spectroscopy, including X-ray emission, X-ray photoelectron, and Mössbauer. Wherever possible the results are interpreted within a theoretical framework which again leans heavily on molecular-orbital and band theories, although consideration is also given to valence-bond, crystal-field, ligand-field, and Brillouin zone theories.

In general the book is a happy blend of fact and theory. If the book has a drawback, it is that the important category of sulphosalt minerals has not been included; however, there are practical limits to the size of a volume, and it is difficult to suggest topics that should have been eliminated or curtailed in favour of sulphosalt coverage.

The book is copiously illustrated with line drawings, which, for the most part, are clear and legible, the text is well referenced, the quality of the paper is good, and the type comfortably legible. The book deserves a prominent place on the reference shelves of mineralogists and other technologists whose interests include sulphides, and it is easy to see it as a textbook for courses in sulphide mineralogy. For specialists in sulphide research, the book provides a very useful and up-to-date review of sulphide properties, and the principles and techniques involved in their study.

E. H. NICKEL

Pies (W.) and Weiss (A.). *Crystal Structure Data of Inorganic Compounds. Part f. Key Elements: d^4... d^8 Elements.* (Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology, New Series. *Group III. Crystal and Solid State Physics. Vol. 7*). Berlin, Heidelberg, and New York (Springer-Verlag), 1977. xxvi+778 pp., 14 figs. Price DM 780 ($343.20).

This large and very expensive volume is one of a series of eight (six of tabulation plus reference and index volumes) in the Volume III/7 series, of which III/7a and III/7e have already been published. The key elements referred to in the title are Cr, Mo, W, Mn, Tc, Re, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, and Pt, crystal structure data being tabulated for those multiple oxides which contain these elements in an anionic (or 'pseudo-anionic') grouping (e.g. chromates, molybdates, tungstates, etc.). Within these key element groups the compounds are arranged in order of increasing atomic number of the associated elements.

The information compiled includes the chemical formula and mineral name (where appropriate), space group, lattice constants, number of formula units in the unit cell, density, structure type, scope of the structure determination, and method used. Finally, where available, additional data, such as optical properties, morphology, phase relations, and magnetic properties, are listed. References are given by referring to the relevant volume of Structure Reports.

Despite the lack of an index with this volume, the tables are fairly easy to use, once the chemical classification scheme is understood, but the lack of direct reference to the source material could prove a disadvantage. Obviously the vast majority of the inorganic compounds listed have no naturally occurring counterparts, but the series should provide a compact source of structural data in the wider field of inorganic crystal-structure studies.

A. M. CLARK

Klemm (D. D.) and Schneider (H. J.), editors. *Time- and Strata-bound Ore Deposits.* Berlin, Heidelberg, and New York (Springer-Verlag), 1977. xviii+444 pp., 160 figs. Price DM 86.00.

This *Festschrift* in honour of Professor Albert Maucher's seventieth birthday, organized in 1975–6 has been produced in good time, and forms a fitting tribute to 'that unflagging advocate of the idea of time- and strata-bound ores' (I quote the dedication). Maucher has indeed been in the van of synsedimentary interpretation and is to be regarded as one of the architects of contemporary notions on layered or layer-controlled ore deposits. The articles nevertheless range widely both in geography and philosophy.

General topics include a contemplative discussion of time in ore genesis by V. I. Smirnov, who is prepared to accept sedimentary origin of the Pb/Zn ores of Karatau (Kazakhstan) in the Devonian followed by activity of migrant solutions in the Carboniferous. His comments on the general absence of clasts of ore from the roof-rocks of supposedly sedimentary ores are interesting. L. J. Lawrence also sees the possibility of a transition from syngenesis to epigenesis at Mount Morgan (Australia). E. T. Degens and P. Stoffers contribute